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\title{Cassini Titan Radio Science)
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\event{PS4 Titan's atmosphere and surface : recent developments}
\organizer{Dr. Athena Coustenis,Prof. Frederic W. Taylor }
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\begin{document}
The Cassini Radio Science instrument consists of two principal parts. On the spacecraft there are the Radio Frequency Instrument Subsystem(RFIS), which consists equipment devoted entirely to radio science, and the Radio Frequency Subsystem(RFS), which is mostly devoted to spacecraft telecommunications, but which also contains the Ultrastable Oscillator(USO) . Between them, these subsystems provide the capability to transmit signals at three frequencies - X-band (3.4 cm), S-band (12 cm), and for the first time, Ka-band (1 cm), whose frequency can be referenced either to an X-band uplink, a Ka-band uplink, or to the USO. On the ground, there are the 70 m antennas of the DSN at Goldstone, California, Canberra, Australia, and Madrid, Spain to receive the X- and S-Band signals, and a 34 m station at Goldstone instrumented to receive X- and Ka-band signals. It is expected to also have available non-DSN Ka-band stations in Italy and possibly Japan.
The two principal radio science investigations at Titan are atmospheric and ionospheric occultation experiments, and gravity field and celestial mechanics observations. The objectives of the occultation experiments are: to determine the global fields of temperature and pressure in the middle and lower atmosphere of Titan at high vertical resolution down to the surface, from which the latitudinal dependence of zonal winds can be deduced; to constrain the distribution of tropospheric methane and the surface relative humidity; and, to conduct a search for Titan's ionosphere. This will be done by observing the effects refraction and absorption on the S- and X-(or Ka-) band signals during occultations, which must occur at a wide range of latitudes.
The objectives of the gravity field and celestial

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mechanics measurements are: to determine the gravity
field and measure the tidal deformation changes between
perikrone and apokrone; and
to improve the knowledge of Titan's ephemerides.
Determination of the precise nature of
Titan's gravity field will reveal its internal structure
and determine the extent of differentiation
and the presence or absence of a metallic or silicate
core. These experiments will be carried out
by means of 2-way or 3-way Doppler tracking and ranging.
This work was carried out at the Jet Propulsion
Laboratory, California Institute of Technology,
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